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ABSTRACT

This Cooperative Extension Service publication from Mississippi State University is a training guide for commercial pesticide applicators. Focusing specifically on the treatment of seeds with pesticides, this publication is meant to prepare one to take the written examination for Environmental Protection Agency Seed Treatment certification. Contents include: seedling disease development, some of the disease causing organisms associated with seedling diseases, cereal grain insects, pesticide labels, seed treatment fungicides and pesticides, seed treatment equipment, operation, calibrating a slurry or liquid seed treater, federal and state labeling requirements for treated seeds, and seed treatment safety precautions. (MR)

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training for certification

Cooperative Extension Service
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Seed Treatment

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FOREWORD

This training manual is intended to provide you the essential information to meet the Environmental Protection Agency standards on Seed Treatment and prepare you to take the written examination for certification. It is not intended that this training will provide you all the knowledge you need for effective seed treatment. Additional information in the form of publications and short courses can be obtained from the Mississippi Cooperative Extension Service.

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Seed Treatment

Maintaining the quality of seed is dependent on many factors. Some of which are: (1) Moisture, (2) Temperature, (3) Humidity, and (4) Storage Conditions.

Even though the factors listed above are properly taken care of, all seed may contain seed-borne diseases, and they are subject to be damaged or destroyed by insects and other pests. Research has shown that treating seed with one or more pesticides is the most economical and efficient way to protect seed from these pests. Since pesticides are poisonous, extra care and safety precautions must be taken when applying them and in handling the seed after they have been treated.

Definition of Treated Seed

The term "treated" means given an application of a pesticide or subjected to a process designed to reduce, control or repel disease organisms, insects, or other pests which attack seeds or seedlings grown from treated seed.

Seeds Normally Treated

The kinds of seeds that are normally treated with one or more pesticides are: corn, peanuts, cotton, sorghum, wheat, oats, rye, barley, millet, soybeans (under some conditions), pine tree and most vegetable seeds.

Internally and Externally Infested Seed

Many seed normally bear a heavy load of microorganisms. In addition several kinds of bacteria and fungi find their way into the interior of seed. The soil in which the seed is planted is also well populated with many kinds of microorganisms, some of which are often times destructive to the seed and some are quite beneficial. Internally and externally infested seed may be means of introducing diseases into a crop even though the soil is free of potential dangerous disease organisms. There is a very long list of diseases which the seed are the principle source of introducing disease organisms. Some examples of such diseases are smuts of small grains, bacterial blight of cotton, certain virus diseases of soybeans and many others. There are many other diseases where the seed are a means, among others whereby disease organisms may be transferred to disease free fields. Examples of such diseases of importance in Mississippi are septoria leaf and glume blotch of wheat, brown spot of rice, cercospora leaf spot of peanuts and others. The primary control of these diseases, which are carried on and/or within the

seed is maintaining seed production fields free of those diseases transmitted by the seed. The presence of certain seed transmitted organisms can be reduced in many cases by proper seed treatment fungicides.

One of the most critical periods in the life of a plant is from the time the seeds are placed in the soil to the establishment of the young plant as an independent organism. During this time the young plant is very tender and succulent and very susceptible to the attack of various disease causing organisms. Diseases that occur on the newly planted seed and young seedlings are referred to as seedling diseases.

Seedling Disease Development

Seed rot. This is simply a rotting of the seed before it germinates. Seed rot can be encouraged by planting poor quality seed which may have cracks in the seed coat through which seed rotting organisms in the soil may enter and result in rotting. Poor quality seed are generally slower germinating increasing its exposure time to potentially seed rotting organisms. The slower germination also increases the possibility of the presence of environmental conditions which favor the development of disease.

Pre-emergent damping off. This is the occurrence of seedling disease prior to the emergence of the seedling from the soil.

Post-emergent damping off. This phase of seedling disease occurs after the seedling has emerged from the soil. One symptom of this disease on soybeans and cotton is called soreshin. This is a reddish-brown lesion at or near the soil line. This phase of seedling disease may be evident as wilted plants which generally die quickly. Plants with only partial girdled stems may survive but are reduced in their vigor by the presence of the stem lesion which restricts the movement of water and nutrients through the plant essential for growth and development.

Root Rot. As the name implies this is simply a rotting of part of the root system to all of it, resulting in plant death. In cases where only part of the root is affected some plants tend to replace the rotten roots with new roots just below the soil line. These new roots are frequently placed in the area of the soil where the herbicides have been placed causing adverse effects to future plant growth and development. During periods of dry weather such plants are very subject to drought stress due to the shallow root system.

Some of the Disease Causing Organisms Associated with Seedling Disease

Rhizoctonia solani: This fungus is one of the most common fungus inhabitants of the soil. It is primarily a problem during wet, cool conditions. The environmental conditions which favor the growth and development of this fungus are unfavorable for the growth and development of some plant types such as cotton. The growth and development of the cotton plant is slowed and the plant is weakened, thus more susceptible to the disease caused

by this fungus. Rhizoctonia is responsible for the disease soreshin which can cause pre- and post-emergent damping off.

Pythium deBaryanum, P. ultimum, P. aphanidermatum, P. irregulare. These fungi belong to a group called the water molds. During a particular phase in the development of this fungus water is essential for mobility thus making the presence of water necessary for proper development and spread of diseases caused by this fungus. It is frequently involved with root rots of seedlings. The growth and development of Pythium is favored by soil temperatures higher than those favored for the growth and development of Rhizoctonia. Pythium like Rhizoctonia is a common soil inhabitant. Neither of these fungi are ordinarily seed borne. In certain years Pythium is a problem and other years Rhizoctonia may be a problem. This is brought about strictly by the differences in environmental conditions required for the growth and development of each fungus. Pythium and Rhizoctonia are not always the major organisms involved in stand losses. At times environmental conditions favor the growth and development of organisms other than Rhizoctonia and Pythium. Under such conditions these other organisms may be primarily responsible for stand losses.

Fusarium monififorme and other Fusarium species. The Fusaria are also common soil inhabitants and are frequently associated with seedling disease but not as frequently as Rhizoctonia and Pythium. Fusarium unlike Pythium and Rhizoctonia is occasionally seed borne.

Other Organisms Associated with Seedling Disease are Macrophomina phaseoli (soil inhabitant), Sclerotinia sp. (soil inhabitant), Heliminthosporium sp. (soil-borne, air-borne and seed-borne), Phytophthora sp. (water mold).

Cereal Grain Insects

Rice Weevil: Found in all grains, it is the most common and most destructive of the stored grain insects. A small snout beetle, it flies and sometimes infests grain in the field before harvest. The larva burrows into the heart of the kernel where it feeds and passes through the pupa stage. It emerges as an adult, cutting a small hole through the kernel, ("weevil exit-hole").

Granary Weevil: This insect is very similar to the rice weevil and can only be distinguished from it by microscopic examination. It cannot fly.

Angoumois Grain Moth. The adult is a dull gray. The larvae bore into the kernel, pass through the pupa stage, and emerge through a small round hole cut in the outer layer of the kernel. The moth breeds on the surface of the grain.

Lesser Grain Borer. This is a small beetle, dark brown to black with its head turned down under the front part of its body. It is a strong flier and can live under much drier conditions than most of the other stored grain insects.

Cadelle Beetle. This is one of the largest stored grain insects and is black in color. The larvae burrow into the woodwork of bins and can stay there to infest new grain. This larva is white in color with a black head and two horny black points at the end of their bodies.

Saw-toothed Grain Beetle. This is a reddish-brown to black insect which has 6 saw-toothed projections on each side of the front part of the body, visible under microscope.

Confused Flour Beetle. The confused flour beetle, saw-toothed grain beetle and flat grain beetle are commonly referred to as "bran bugs". The confused flour beetle is reddish-brown and is one of the most common storage insects both in elevators and mills.

Flat Grain Beetle. This is one of the smallest stored grain beetles. It is a flattened, oblong reddish-brown beetle with an antennae about 2/3 as long as the body.

Indian-Meal Moth. This moth has wings that are reddish-brown with a coppery luster on the outer two-thirds, with the rest light gray. The larvae may completely web over the surface of the infested grain. This moth is particularly common in corn storage and in packaged feed and meal.

Pesticide Labels

Before using any pesticide read and understand the information on the label. The label contains detailed information about the product. Some of which are: (1) Active ingredient, (2) Inert ingredients, (3) Warning statement; such as - Danger - Keep Out of Reach of Children or Poison and Handle with Care, (4) Antidotes, (5) Type seed and rate per bushel, (6) Kind of pests controlled, (7) Care in handling and use of treated seed, and (8) Disclaimer or warranty clause.

Seed Treatment Pesticides

Fungicides. Fungicidal seed treatment may be divided into three categories, depending on the nature and purpose of the treatment. These categories are: (1) Seed disinfection, (2) Seed disinfestation, and (3) Seed protection. NOTE: A given fungicide may serve in one or more of these categories.

Seed disinfection - Disinfection is the elimination of a pathogen which has penetrated into living cells of the seed, infected it and become established.

Seed disinfestation - Disinfestation is the control of spores and other forms of pathogenic organisms found on the surface of the seed.

Seed protection - Seed protection is chemical treatment to protect the seed and young seedling from pathogenic organisms in the soil.

Seed treatment materials are usually applied to seed in one of three forms: (1) Dust, (2) Slurries (a mixture of wettable powder in water) and (3) Liquids.

Based on composition, seed treatment fungicides may be organic or inorganic, metallic or non-metallic and until recently mercurial or non-mercurial. Before the cancellation of the volatile mercurials, fungicides for treatment seed were generally classified as volatile and non-volatile. With the elimination of the volatile mercurials, most fungicides now approved for use on seed are classified as non-volatile. When using this type material, complete coverage of the seed is necessary to obtain effective control.

For many years it has been known that by coating the seed with certain chemical formulations it is possible to reduce the associated microbial flora to the extent that properly treated seed will produce better stands of seedlings than will untreated seed.

Seed treatment with the proper fungicide at the proper rates is perhaps the cheapest insurance a producer can purchase to obtain a good stand. However, when conditions are optimum for disease development a loss of stand may occur even with proper seed treatments. The primary purpose of seed treatment fungicides has been to aid in the prevention of stand losses. The volatile mercuries that were commonly used as seed treatments acted as a seed disinfectant, disinfestant and a seed protectant. The volatile mercuries have been replaced with fungicides that act to a limited extent as a disinfectant and seed protectant. For the most part after the seed have germinated the young seedling becomes exposed to soil teaming with disease organisms. To obtain additional protection producers may invest in additional fungicides through planter box or in-the-furrow applications.

In the case of some crops fungicide combinations are applied to the seed surface. Combinations are used to increase the spectrum of disease causing organisms controlled. For instance, all fungicides suggested in Mississippi for use on cotton seed are combinations of two fungicides. One being in most cases effective against Rhizoctonia while the other is active against Pythium.

Certain organic fungicides have been reported to act as safeners to certain systemic insecticides which may cause injury to the seed. It has been suggested by research that the harmful effects of certain systemic seed applied insecticides can be reduced by first applying the fungicide to the seed surface and the insecticide last.

Insecticides. Insecticides are often applied to seed to control or reduce insect damage to seed during storage and to a lesser degree to prevent damage from such insects as, wire worms and seed corn maggots in the soil.

Since some of the pesticides are selective in the control of pests, many times two or more compounds are combined in the treater tank, or an extra tank may be used, to give the spectrum of activity needed.

The manufacturers of pesticides are now making combinations available to seed processors, but should a processor blend two or more pesticides the compatability of the materials must be determined, as some combinations of

materials may seriously reduce seed germination. When applying two or more pesticides at different times the sequence of application is also important.

Whether a single pesticide or a combination is to be applied to the seed, read the label and follow the manufacturer's directions carefully.

Seed Treating Equipment

Commercial seed treaters are designed to apply accurately measured quantities of pesticides to a given weight of seed. Basically, there are three types of commercial seed treaters on the market: (1) Dust Treater, (2) Slurry Treater and (3) Direct Treaters - the Panogen and Mist-O-Matic treaters are examples of the Direct Treaters.

Operation

Controlling the Flow of Seed. The amount of seed which flows into the weigh pan (which is just beneath the feed hopper on top of the treater) is controlled by opening or closing the gates of the feed hopper by means of the hand wheel on the side of the hopper. The scale on the hopper shows how far gates are open in inches. Gates should be open to whatever number of inches it takes to keep the weigh pan filled to the required number of pounds per dump as it tilts in either direction. The number of pounds per dump is adjusted by correctly setting the counterweight up or down on the counterweight arm.

Powder Application. To ascertain that the correct amount of powder is being applied to the seed flow, a preliminary test must be made, in which a given number of pounds of seed (such as 100 lbs.) is run through the feeder. During this run, the measuring cup provided with the feeder should be used to catch the powder as it comes off the vibrator. After the given amount of seed has run through, the powder should be weighed so as to determine how much is being applied to that amount of seed. The vibrator speed can then be adjusted accordingly. Then another or more tests should be run until proper setting of the vibrator speed is determined for correct coverage.

Approximate Setting

No. Dumps	Powder Scale Opening	Syntron Setting	Oz. Produced/100 lbs.
25	1/2	60	2
25	3/4	60	5
25	3/4	70	6
25	3/4	80	7
25	1	60	10

Number 4 on counterweight arm gives five pounds per dump.

Slurry Seed Treater. The slurry treatment principle involves suspension of a wettable powder treatment material in water. The treatment material applied as a slurry is accurately metered through a simple mechanism composed of a slurry cup and seed dump pan. The cup introduces a given amount of slurry with each dump of seed into a mixing chamber where they are blended.

While operation of slurry treater is relatively simple, the various operation procedures must be thoroughly understood.

1. The metering principle is the same in direct, ready-mix or fully automatic treaters, i.e., the introduction of a fixed amount of slurry to a given weight of seed.

2. To obtain a given dump weight, slurry treaters are equipped with a seed gate that controls seed flow to the dump pan. With the proper seed gate setting, a constant dump weight for a given seed can be obtained.

3. The amount of treatment material applied is adjusted by the slurry concentration and the size of the slurry cup or bucket. As the dump pan fills, a point is reached where it over balances the counter weight and dumps into the mixing chamber. This brings the alternate weighing pan in position to receive the inflow of seed and activates a mechanism to add a cup of slurry to the mixing chamber. Thus, one cup of slurry is added with each dump of seed.

4. The mixing chamber is fitted with an auger type agitator that mixes and moves seed to the bagging end of the chamber. The speed of the auger is important because at slow speeds more uniform distribution is obtained.

Slurry tanks have 15 to 35 gallon capacities depending upon the size of the treater. They are equipped with agitators that mix the slurry in the tank and keep it suspended during operation. It is important that the powder be thoroughly suspended in water before treating. If the treater has been idle for any period of time, sediment in the bottom of the slurry cups must be cleaned out.

The proper size slurry cup must be used. Most machines now have cups with ports and rubber plugs for 15 cc, 23 cc, and 46 cc quantities. Some users prefer to mix the slurry in an auxiliary tank and then transfer to the slurry chamber as needed.

Direct Treaters. Direct treaters are the most recent development and include the Panogen and Mist-O-Matic treaters. These two were initially designed to apply undiluted liquid treatment. Instead of applying 23 cc of material per 10 pounds of wheat, as in slurry treaters, they apply 14 to 21 cc (1/2 to 3/4 ounces) per bushel of wheat. This small quantity of material is suitable only with liquid materials which are somewhat volatile and do not require complete, uniform coverage for effective action.

Later modifications for treaters include dual tanks that permit simultaneous addition of a fungicide and an insecticide, and adaptations for the application of slurries. The metering device in both treaters is similar to that of the slurry treater, since it is attained through synchronization of a treatment cup and seed dump. Otherise, they differ decidedly from the slurry treater and from each other. Both of these direct treaters have an adjustable dump pan counter weight to adjust the weight of the seed dump. This is not practical with slurry treaters.

Panogen Seed Treater. The operation of the Panogen treater is relatively simple. A small treatment cup, operating from a rocker arm directly off the seed dump pan and out of a small reservoir, meters one cup of treatment with each dump of the seed pan. Fungicide flows through a tube to the head of the revolving drum seed mixing chamber. It flows in with seed from the dumping pan and is distributed over the seed by the rubbing action of the seed passing through the revolving drum.

The desired treating rate is obtained by the size of the treatment cup and adjusting the seed dump weight. Treatment cup sizes are designated by treating rate in ounces and not by actual size, e.g., the 3/4 ounce cup applies 3/4 ounce (22.5 cc) of treatment per bushel with six dumps per bushel. Actual size of this cup is approximately 3.75 cc.

Mist-O-Matic Seed Treater. The "mist-o-matic" treater applies treatment as a mist directly to the seed. The metering operation of the treatment cups and seed dump is similar to that of the "Panogen" treater. Cup sizes are designated by the number of cc's they actually deliver, e.g., 2½, 5, 10, 15, 20 and 40. The treater is equipped with a large treatment tank, a pump and a return that matintains the level in the small reservoir from which the treatment cups are fed. After metering, the treatment material flows to a rapidly revolving fluted disc mounted under a seed spreading cone. The disc breaks drops of the treatment into a fine mist and sprays it outward to coat seed falling over the cone through the treating chamber. Just below the seed dump are two adjustable retarders designed to give a continuous flow of seed over the cone between seed dumps. This is important since there is a continuous misting of material from the revolving disc. The desired treating rate is obtained through selection of treatment cup size and proper adjustment of the seed dump weight.

Calibrating a Slurry or Liquid Seed Treater for the Correct Dosage

1. Determine how much liquid your treater's metering cup or bucket will dump into the seed each time the weighted seed pan trips. Record for future use.

2. Run seed slowly into the treater until the weighted seed pan dumps seed into the treater. Shut off the feed to the treater immediately. Weigh the amount of seed dumped into the treater. Record the setting of the weight on the weight balance arm and the weight of the grain dumped for future use.

3. Determine the number of dumps per bushel, by dividing the weight per dump into the bushel weight of your seed. For example, a treater dumps 6 pounds of wheat each time the seed pan trips. Dividing 60 pounds per bushel by 6 gives 10 dumps per bushel.

4. Determine how much of the liquid or slurry you are applying per bushel of seed. To do this, multiply (1 above) the amount of chemical your metering cup dumps into the seed by (3 above) the number of dumps per bushel. Since most metering cup capacities are measured in cc while the chemical recommendations are in ounces per bushel, divide the result by 29.57 to give the liquid ounces per bushel applied.

$$\frac{\text{Metering cup capacity in cc}}{29.57\ \text{cc}} \times \text{Number of dumps per bushel} =$$

ounces of liquid applied per bushel.

For example: $\frac{46\ \text{cc} \times 10\ \text{dumps}}{29.57} = \frac{460}{29.57} = 15.6$ oz. liquid per bushel.

5. To determine the correct amount of powdered chemical to add to one gallon of water for a slurry mixture, divide 128 by the number of ounces of liquid applied per bushel, and multiply the result by the ounces of the chemical you want to apply to one bushel.

$$\frac{\text{128 ounces per gallon}}{\text{Oz. liquid applied/bu.}} \times \text{Oz. powdered chemical desired/bushel} =$$

Ounces of slurry to add to one gallon of water.

For example:

$\frac{128}{15.6} \times 1.5 = 12.3$ ounces powdered chemical to add to one gallon of water. NOTE: For additional information see the Calibration instruction manual furnished with each machine by the manufacturer.

Requirements Under the Federal and State Seed Laws for Labeling of Treated Seed

Information required to be shown on the label:

1. A word or statement in type no smaller than 8 points indicating that the seed has been treated.

2. The commonly accepted, coined, chemical or abbreviated chemical (generic) name of the applied substance and the rate of application.

3. A caution statement if the substance used in such treatment in the amount remaining with the seed is harmful to humans or other vertebrate animals.

4. Seed treated with a mercurial or similarly toxic substance, shall be labeled to show a statement such as "poison treated" in red. In addition, the label shall show a representation of a skull and crossbones.

5. Seed treated with less toxic substances, if the amount remaining with the seed is harmful to humans or other vertebrate animals shall be labeled to show a caution statement in type no smaller than 8 points, such as "Do Not Use for Food, Feed, or Oil".

Coloring Grain Seed Treated with Poisonous Substances

All interstate shipments of the food seeds; such as, wheat, corn, oats, rye, barley and sorghum bearing a poisonous treatment in excess of a recognized tolerance or treatment for which no tolerance or exemption from tolerance is recognized must be denatured by a suitable color to prevent their use as food, feed or oil.

Many of the pesticides now come from the manufacturer with the dye or color added as a convenience to the operator; however, some seed processors prefer to mix the dye with the pesticide at the plant so that the desired color may be obtained. Most all treated seed are now colored, with the dye causing no apparent injury to seed germination or danger to personnel processing or using the seed.

Pesticide Carriers, Binders and Stickers

These materials are listed on the label as inert ingredients. There is no requirement that the name of these materials be given. They are selected by the manufacturer and are usually neutral in pH, non-toxic to humans and causes no apparent damage to the germination of the seed.

Safety Precautions

A. Hazards associated with handling, sorting, mixing and storage of treated seed.

1. Read the label and follow instructions carefully as over treatment may injure the seed and under treatment will not control the pest.

2. When handling mercurials or similarly toxic substances, the operating personnel must be provided with protective clothing such as: (a) Coveralls, (b) Cap, (c) Protective Glasses, (d) Rubber apron, (e) Rubber boots, (f) Rubber Gloves, and (g) Respirator designed for

use with the material. Personnel should not inhale the dust or vapor nor permit the material to contact the skin or eyes. Operator should wash thoroughly with soap and water before eating and smoking. Bathe immediately after work and change all clothing. Wash clothing thoroughly with soap and hot water before re-use. In case of contact, immediately remove contaminated clothing and wash skin thoroughly with soap and water.

3. A safety shower should be installed in the immediate vicinity of the treater.

4. An exhaust system should be installed to remove vapors and dust from the operating area. The exhaust air should discharge into a cyclone or bag-type dust collector. The treater should also be vented and tied into the exhaust system.

5. Seed treaters should be isolated and not operated in the vicinity of other personnel or farm commodities that are to be used for food, feed or oil.

6. Special multiwall (3 or 4 ply) or tightly woven bags are recommended for seed that has been treated with mercurials or similarly toxic substances. Seed should be thoroughly dry before going into the bag as excessive moisture can cause rapid deterioration of the seed.

7. Store treated seed in a dry, cool place away from food or feed products.

8. Seed treaters should be thoroughly cleaned after use as some of the pesticides are corrosive and others settle out and cause clogging of the equipment. Do not run contaminated water into stream or public sewer, but discharge into a shallow ground pit.

B. Hazards associated with the use of treated seed and the disposal of unused treated seed and empty pesticide and treated seed containers.

1. The user of treated seed should read and follow the label carefully.

2. Planter hoppers should be filled outdoors.

3. Do not breathe dust or fumes from treated seed or get in eyes or on skin. Wash thoroughly with soap and warm water after handling treated seed.

4. Use treated seed as seed and do not introduce them into the food and feed channels; for to do so, may cause serious injury to poultry, livestock and humans.

5. Do not re-use pesticide containers. Destroy them by mutilation and burying at least 18 inches deep in an isolated area away from water supplies. NOTE: On 55 gallon drums follow manufacturer's recommendation for decontamination and container disposal.

6. Empty treated seed containers and low germination seed should be destroyed by burying at least 18 inches deep in an isolated area away from the water supplies. NOTE: Treated seeds exposed on soil surface will be hazardous to birds and wildlife.